JOURNAL

OF THE

AMERCAN FOUNDRYMEN'S ASSOCIATION.

VOL. 6. MARCH, 1899. NO. 33.

The American Foundrymens' Association is not responsible for any statement or opinion that may be advanced by any contributor to this Journal.

PROCEEDINGS OF THE WESTERN FOUNDRYMEN'S ASSOCIATION.

The regular monthly meeting of the Western Foundrymen's Association was held Wednesday evening, Feb. 15, at the Great Northern Hotel, Chicago, Vice-President A. M. Thompson in the chair.

The following topical questions were brought up for discussion: What is your experience in regard to sand burning on castings so hard it must be chipped off? What causes it, and what can be done to prevent it? What has been your experience with the use of core compounds?

Both of these questions were discussed to a considerable extent, and it was decided to have the secretary secure a paper on core compounds to be presented at an early meeting of the association.

A resolution was adopted providing that future reports of meetings in trade papers and the official proceedings only include in full papers which will be read before the meetings, with any written discussions on them that may be presented, and that no stenographic report of the discussion on questions before the meetings be printed.

A motion was also carried for the appointment of a committee of three to confer with foundrymen regarding the attendance at the meetings, and to secure a larger attendance and membership. The chair appointed R. J. Cleveland, A. M. Thompson and W. A. Jones to serve on this committee.

PROCEEDINGS OF THE PITTSBURG FOUNDRYMEN'S ASSOCIATION.

The regular monthly meeting of the Pittsburg Foundrymen's Association was held on Monday evening, Feb. 27. The usual routine business was transacted, and the committee on the reception of the national organization in convention next May reported that sub-committees had been appointed and that considerable work would have to be done by the members of the association outside of those actually on committees.

An interesting exhibit of test bars was presented. The set was one of those made for the committee of the American Foundrymen's Association on standardizing the testing of cast iron, and was cast by Thos. D. West, of a soft Bessemer or ingot mold iron. The whole test, embracing round and square bars of a great variety of sizes, was cast at one time.

The principal feature of the evening was the address by Mr. Walter Kennedy, who has recently returned from China, where he was engaged for some time by the government in connection with their steel works and rolling mill. Mr. Kennedy was scheduled to speak on "Chinese Foundry Practice," but he showed that this was an unknown quantity, and devoted most of the time to a general description of his experiences in China. Only an abstract of Mr. Kennedy's very interesting address can be given. His first experience was with apparatus being run as a blast furnace. There is scarcely any distinction in China between a blast furnace and a cupola. This blast furnace was about 12 feet high, built on a hillside, and shaped like the frustum of a pyramid. There were two tuyeres, and the blast was furnished by a feather-packed piston working in a box about 20 inches square, and operated by 18 men, who took turns, one at a time. The cast amounted to about 60 ponds. Mr. Kennedy's next experience was with an affair which had been built for a cupola, but was being used as a blast furnace, using ore and scrap. It was about five feet high, with one tuyere, the cast being between 25 and 30 pounds. At this place they were making kettle castings,

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which were of very fine quality, the thickness being not over an eighth of an inch, while the kettle was about 30 inches in diameter. At another place, the cupola was in three stories, having a total height of about eight feet. The sections were bolted together, and the bottom one was used as a ladle. When enough iron had accumulated in the bottom part, the two top parts were taken off and the bottom used as a ladle. The labor employed at all these places was the cheapest and most ignorant.

Mr. Kennedy first went to China at the instance of Calvin S. Brice, to make an estimate on the cost and feasibility of building a railroad from Han Kau to Pekin. This project fell through, and he was then employed by the Chinese government in connection with the government iron works. While he had 16 titles at one time, he was not permitted to hire or discharge a single man, this being reserved for the Chinese officials, who levied tribute on all the employes, those who would surrender the greatest part of their earnings being thus in favor, so that the class of labor employed in the iron works was the very worst there was. In six years they had made about 300 tons of rails, and there was little chance of doing any better until by a dint of effort Mr. Kennedy succeeded in securing actual authority to run the works as he desired. Then they made about 3,000 tons in eight months, but as soon as any department showed any signs of running properly, it was desired to turn it over to the Chinese officials.

There was in the government works a great deal of fine machinery, which had been ordered from England, Germany and elsewhere, but much of it they had no knowledge of, and some machines had been put together by ignorant coolies, with the result that gears which should mesh were sometimes several inches apart. The first department gotten in shape was the rail mill. When they succeeded in making 10 rails a day—about five tons—it was considered a great achievement, and when the production got up to 60 tons, the officials were highly satisfied and wanted the bar mill put in operation to make splice bars, etc. Finally there were seven departments gotten in running order.

The whole Chinese system is such that there is little opportunity for American skill and enterprise, because the authority must rest in the officials, who frequently pay for the privilege of holding positions in which they can extort money from the laborers, and the works are filled with the laborers who will pay the greatest tribute, while as soon as the officials think they have learned how to do anything, they at once want to do it themselves, generally with disastrous results.

PROCEEDINGS OF THE PHILADELPHIA FOUNDRYMEN'S ASSOCIATION.

The regular monthly meeting of the Foundrymen's Association was held at the Manufacturers' Club in Philadelphia on Wednesday, February 1, the president, P. D. Wanner, occupying the chair.

The Executive Committee's report, after detailing the trusts recently formed in different branches of trade, stated: "We do not find that the makers of iron castings have taken any steps toward the formation of a pool, nor do we think it likely they will, although perhaps such an arrangement, if possible, might be a good thing for the trade. From the fact that there are so many different kinds of castings made it would seem that a combination would be an impossibility. We hope, however, that the time will come when foundrymen will be better paid for their products than they are to-day. At this meeting the matter is to be talked over, not in any way looking to the formation of a trust, but for the purpose of instilling into the minds of foundrymen the fact that they will never get higher prices for castings unless they ask for them. Among the trusts or pools formed it is noticeable that the manufacture of pig iron, fire brick, foundry supplies and equipment is not covered, nor do we think from the present outlook that there is any likelihood of trusts being formed in these lines."

Upon motion of Geo. C. Davis a committee of one was appointed to wait upon A. B. Farquhar, of York, Pa., to request his attendance at the next meeting to make an address on the business situation, and particularly in regard to the effects of trusts upon trade in general.

The meeting then went into a long discussion upon the subject of prices of castings. The consensus of opinion appeared to be that better prices should be obtained for foundry products, and that the only way to get them was to stick to prices quoted, and not be beaten down to the prices of a competitor who was willing to cut even to cost price to secure business. While a

general agreement as to prices could hardly be aimed at, still it was thought a great deal could be accomplished in all localities by the foundrymen in those localities standing together and supporting each other in an effort to maintain quoted prices instead of resorting to the evil practice of underbidding, a practice which appeared to have been carried beyond all bounds.

The secretary read several letters from concerns at a distance from Philadelphia, all expressing themselves as ready to support any movement tending to raise prices of castings.

The Abram Cox Stove Company, Philadelphia, were elected to membership in the association.

A paper, "The Malleable Iron Industry: Its Development in the United States," which was a continuation of a paper read at the October meeting of the association, was then read by George C. Davis, as follows:

"THE MALLEABLE IRON INDUSTRY: ITS DEVELOPMENT IN THE UNITED STATES.

By 1835 the malleable iron industry had become quite firmly established in this country, as there were known to be in operation at this time five foundries. Three of these, the Boyden & Crockett foundries in Newark and the East Boston foundry in Massachusetts, have been noticed at length in a previous article. One of the other foundries, owned by Stelwagon & Bryant, and which was located at Susquehanna avenue and Germantown road, Philadelphia, was briefly described by John Dessalet in a letter read before this association at the October meeting. This works was a small one, employing 10 or 12 molders, and like some of the other earlier foundries was an offshoot of the Boyden foundry, as two of its men came from there. It began operations in 1833, and manufactured mainly carriage hardware, coffee mills and other small articles. According to the customs of the times great secrecy was observed, especially regarding the annealing, and only one laborer, selected for his ignorance, was allowed in the annealing room. Mr. Bryant was the practical man of the concern, and carried on many experiments. One attempt to add

something to the molten iron resulted in an explosion, which cost one man his eyesight. The iron was melted in a small air furnace, which could not have been very economical in fuel, as it is stated that flame often showed at the top of the stack, which was 80 feet in height. Newcastle coal was imported in considerable quantities, and the fire brick (Stourbridge) also came from England. These works continued about five years, when the business was abandoned. Another foundry, which has not heretofore been mentioned, was started at Oak Hill, Greene County, N. Y., by Calvin Adams in 1833. A branch of this concern was established at Westmoreland, N. Y., in 1850, and was called the Oak Hill Branch Malleable Iron Company. The original works at Oak Hill was continued for a few years, when it was moved or sold to parties who formed a corporation at Coxsackie, N. Y., where they continued in business for some time. The Westmoreland foundry was operated for a time as a branch of the Oak Hill works, but after severing its connection with the parent foundry it took the name of the Westmoreland Malleable Iron Company, by which it has since been known. Of the five foundries here mentioned one was destroyed by fire and two others were given up during the troublous times of 1837. Other concerns very quickly sprang up to take their places, and the expansion of the malleable iron industry in the decade following was very rapid.

Up to the breaking out of the Civil War there were few, if any, radical changes in the malleable iron industry. With the growth of the country, the business had gradually extended and foundry appliances have been enlarged and improved. The pig iron was obtained, as in the early days, from the Salisbury district, Orange County, and the Champlain district, in New York State, and other furnaces scattered along the Atlantic seaboard from Katahdin in Maine to Stickney in Maryland. About this time there was experienced considerable trouble with the iron owing to changes occurring in blast furnace practice. The warm blast was coming into use, and the natural result was a higher silicon iron, unfitting it in many cases for malleable castings.

As technical chemistry was then an unknown science, there was no reliable method of ascertaining in advance whether a lot of iron would answer or not. Some founders met with considerable losses owing to bad castings, which, though annealed soft, were still brittle. Naturally they attributed all their troubles to the iron—a habit, by the way, that is not altogether unknown in the present day. Steps were taken to remedy the trouble, and in some cases men were sent to the furnaces disguised as workmen to find out whether the hot blasts were the sole cause of the difficulties, or whether it was due to different ores. One manufacturer sent a man to visit the charcoal furnaces and obtain a sample of pig iron from each. This was sent back to the foundry, melted in a crucible and a trial casting annealed. Such methods as these were expensive and required time before the result could be known. Even then there was no assurance that the next lot of iron from the same furnace would be suitable. Such experiences as these are perhaps worth recording, as they serve to illustrate the changed conditions due to technical methods now in use. At the present time when a founder buys iron he orders it subject to certain chemical specification, and he cares very little where it comes from or how it was made. With the outbreak of the rebellion there arose an increased demand for iron for ordnance work, and the output of many of the blast furnaces which had heretofore supplied the malleable iron founders was absorbed by the United States Government. Fortunately, the Lake Superior region had been developed, and as pig iron from this district was found to be admirably suited for malleable work its use rapidly extended. The first Lake Superior iron was brought into this locality about 1862. The lake regions are still the source of supply of charcoal malleable.

One salient feature of the malleable iron industry is the great amount of experimental work done in attempting to improve the process. From the time Seth Boyden began his elaborate series of experiments down to the present day, neither time nor money has been spared in putting into operation new methods. Most of these efforts have been directed toward improving the

annealing. Of course, we always have had and probably always will have with us the man with the mysterious substance or "flux" which was to be added to the cupola charge or molten iron, and which was to produce malleable iron direct without any subsequent annealing. These metallurgical operations were usually accompanied by some financial operation on the foundryman's bank account, and this being accomplished the man with the flux usually departed just before the heat was to be poured, to be seen no more.

One attempt to introduce a new method of annealing, which was known as the Andrews process, was tried at a number of plants about 1875. The process consisted in passing water gas, which is composed of carbon dioxide, carbon monoxide and hydrogen, over the castings heated to redness. The water gas was generated by passing steam through red-hot charcoal in a retort contained in the large retort in which the annealing boxes were placed. Both the retort for generating the gas and that containing the castings were heated from the same source. The plant consisted practically of a small water gas plant inside of a retort or annealing oven, suitable connections, of course, being provided for passing the gas over the castings and providing for its escape. The process could be made to work fairly well, but the mechanical difficulties of keeping the gas pipes which were subjected to high temperatures in good order were very great. Under the conditions which the Andrews process was installed the proportion of carbon dioxide was probably too large, considerable steam was passing through the charcoal, and this with the mechanical difficulties mentioned above caused the abandonment of the process. The reaction on which the decarbonizing process probably depended was the oxidizing action of carbon dioxide. This gas by itself is so active that both iron and graphite will be attacked; in other words, a scaly casting will result. Provided the carbon dioxide be diluted sufficiently it still is able to oxidize the carbon, but will not attack the iron. At the time the process was introduced the idea was held that the hydrogen combined with the carbon to form some volatile

hydrocarbon. These two elements do not unite directly except at the temperature of the electric arc, when acetylene is formed (Richter's "Organic Chem.," p. 153). In this case, as we are dealing with the ordinary temperature of the annealing retort, less than 1,000 degrees C., it is highly improbable that this reaction could have taken place. Experiments with the Andrews process were carried out at the works of the Westmoreland Malleable Iron Company. F. M. Metcalf, treasurer of this company, has communicated to the writer his experience with this process. His account of the experiments, which extended over several years, is quite interesting, and I quote his letter, merely omitting some of the names:

"Westmoreland, Oneida County, N. Y., Jan. 26, 1899.

"Geo. C. Davis:

"Dear Sir—Replying to your inquiry of the 25th, will say the water in the Andrews process of annealing was dripped into a funnel and ran through a pipe with a trap or bend in the pipe down through the top of the retort into an oval casting called the heater, which was at the top of the retort just above the box of red-hot charcoal which served as a water gas generator. Both received their heat in the same way through the brick of the retort. This was supposed to be sufficient to reduce the water to steam, and to some extent to superheat it, though Andrews did not favor superheating much. Steam passed from the heater into the top of the front of the charcoal box, which was as full of charcoal as practicable, and supposed all to be red hot the same as the annealing boxes and contents when under heat. The steam having no other outlet and the charcoal box being steam and gas tight it passed down through the hot charcoal box into a pipe leading under and by latch connections into the annealing boxes. In passing through the hot charcoal it was theoretically converted into hydrogen and carbon monoxide. Over the opening in the charcoal box where the gas made its exit was an iron basket to protect the outlet from getting full of charcoal. There was very little pressure, as there was nothing but a 6 or 8-inch column of water in the trap to prevent the steam

backing out, and I think we had no check valves. I think I suggested higher pressure and hotter steam to Andrews, but he did not favor the steam being very dry, as I think he had tried superheated steam. The original charcoal box was rectangular, and say about 5 feet long. It was charged with charcoal through a luted door at the end and filled as full as possible, always fullest at the back, and after running a day or two was, of course, exhausted to a considerable extent. This reduced the depth of hot charcoal through which the steam was obliged to pass to so shallow a mass that it was thought that at that point the steam was not effectually converted, and to that we attributed the scaling to which I referred in my last letter. As Andrews was about to build another such furnace in Newark, and intended to change the shape of the charcoal box to remove this difficulty, we discontinued using the process and awaited the result of the change. An upright cylindrical box was made for the Newark furnace, the idea being merely to keep it nearly full at all times, as was more easily done in an upright box, at least as high up as it got heat, and thus insure a uniform and sufficient depth of charcoal to thoroughly convert the steam into gas of the right kind.

"This effort failed, as you say, and it was thought by Andrews that the diameter of the charcoal box was too great so that the charcoal did not get heated all through, thus allowing steam to pass that did not get converted. We then did not open up on it again, but about two years later upon the introduction of brick backing into the charge of castings in a furnace that had been built in New Haven we started in again and used this method for some months with fair but not entirely satisfactory results. To improve results we then made a new charcoal box of a bottle shape, and heated it to as high a point from the bottom as was practicable, and hoped by thus passing the steam through as great a depth of hot coal as possible to be successful in getting rid of the carbon dioxide and unconverted steam that caused the scaling, which always appeared to a greater or less extent in some part of the charge of iron, usually at

the bottom where the gas first entered. This failing, we introduced a condenser, and passed the supposed converted gas through it to take out any unconverted steam before passing the gas into the annealing pots. This failed, and then the whole oven failed, and began to disintegrate to such an extent that we did not continue the effort. We have heard of gas annealing ovens that were claimed to be successful, though we could never place them exactly. If you know of any we would be glad to hear of them, as we have always thought that there ought to be some successful way to improve the process by annealing with gas, but we have not hankered ourselves after any more experimenting in that line at such expense as we did the above.

"As we understand it, the process was first used by ———, at ———, where we went to see it. We thought we saw it as it was and became victim No. 2; Ballard & Minchin, of Newark, were No. 3. I went to see their success on the third round of the furnace by Andrews' desire, but he had just completed what I was convinced was the third failure when I arrived, and I never learned whether Ballard survived the great anger under which he was suffering on my arrival or not. Meanwhile, Andrews had just received a letter from the ——— people, saying that they were still using it right along with 'charming results.' Andrews, Minchin and myself went to ——— to see those charming results, and found they were worse than our worst. Shortly after that ——— discontinued using the process, and I think the next furnace was built in ——— shop in ——— for making steel from malleable iron by recarbonizing and also by arresting the decarbonizing process at the steel point. The ——— Company were the fourth victims.

"At this distance of time my sensitive feelings will not be hurt by any reference that you may wish to make to the process and our connection with it, and we certainly have no objections to your so referring to such extent as you wish. We hope no one will think, however, that we have not learned to experiment more conservatively than we did then, though we are always open to improvements. I have answered you at much greater

length than I intended, and hope if you get tired reading the effusion you will be compensated fairly by laughing at the victims, as I have learned to do.

Yours truly,

"F. M. METCALF, Treasurer."

The malleable iron industry has undoubtedly been developed to a greater extent in the United States than in any other country. R. A. Hadfield, "Journal B. I. and S. I.," vol. 1, 1897, page 180, says, in his discussion of a paper by G. P. Royston, on malleable iron: "The author's paper was especially valuable, too, as calling attention to a line of work to which they in the United Kingdom had not paid sufficient attention. That was the production of malleable iron castings, for in America that industry was carried on on a very large scale. Its production had been so thoroughly specialized that he questioned whether they could touch either the price or quality which were being obtained in the United States. A large user in Sheffield had told him that he had to send for execution in America very considerable requirements, the price of castings being exceedingly low, the quality excellent, and the time of delivery short as compared with English makers."

Mr. Hadfield's remarks were made nearly two years ago, but the conditions he mentions are probably the same now as they were then.

At present there are in this country about 90 malleable iron foundries (Directory Iron & Steel Works), varying in capacity from 1 to 80 tons per day. Nearly all of them are located north of the Ohio and east of the Mississippi. They are quite evenly distributed over that region, though of the New England States Maine and Vermont have none. In the Southern States there is only one, and in the entire West from the Mississippi to the Pacific slope not a single malleable iron foundry exists. By far the heaviest tonnage goes into car castings, and farm implements. Since malleable castings are sold so low they have to a considerable extent replaced gray iron castings for many purposes, especially in car building. Broadly speaking, the found-

ers in the Central West are mainly devoted to the heavier castings, while the Eastern foundries manufacture a very large variety of small articles, such as carriage and harness hardware, pipe fittings, bicycle fittings, ship hardware, parts of textile machinery, typewriters, gun locks, pistol frames, and, to use a somewhat hackneyed phrase, "other articles too numerous to mention."

There are at present at least five coke blast furnaces that produce largely malleable pig. Two of these are in New York State and one each in Pennsylvania, Illinois and Tennessee. So the source of supply is not centralized. The coke malleable differs from the charcoal in being a trifle higher in sulphur and considerably higher in manganese. The difference in sulphur is not great enough to be of any importance where the iron is to be melted in an air furnace, as most of it is for malleable purposes, while the high manganese renders coke iron desirable for mixing the charcoal irons, which are, as a rule, too low in this element. Coke malleable has now been in use for about fifteen years, and its consumption is undoubtedly increasing. It was thought at one time that some of the numerous steel casting processes would replace malleable iron. By steel I mean the product of the open hearth or modified Bessemer, and not any of the numerous semi-steels. In the heavier classes of the work this has to some extent proven true, but, as a rule, the two processes are developing along two different lines. The difficulties of preparing small molds to withstand the high temperature of the steels and the more costly plant necessary for its production will probably prevent its use for small or intricate castings.

In closing the writer wishes to acknowledge his indebtedness to Stanley G. Flagg and John Dessalet, of Philadelphia, and F. M. Metcalf, of Westmoreland, N. Y.

Mr. Davis exhibited a lantern slide showing the sketches made by Mr. Metcalf. Mr. Davis also showed some slides of views of the plant of the Embreville Estate, Embreville, Tenn. One view was of the original furnace, and showed the stone slack and old water wheel.

Howard Evans, J. W. Paxson Company, Philadelphia, then showed slides covering a new pulley molding machine and described its operation.

A REVIEW OF THE FOUNDRY LITERATURE OF THE MONTH.

AMERICAN MACHINIST.

Feb. 2. A writer signing the initial "M." says:

"In reply to question 109, by I. C. G., Hackettstown, N. J., in your issue of November 10, for advice about blow-holes in cast boilers for house heating, run on top with flat gates, I venture the guess that they are not blow-holes, in the sense understood by molders, and that the wrong name steered the excellent editorial advice into the wrong channel.

"They are, unmistakably, slag-holes, and, if examined, in a cavity the size of a pea a piece of slag the size of a pin-head will be found in a corner, it being the habit of real slag to throw off gas that forms a clean hole very much larger than itself, and more globular than a blow-hole. The location of the holes around the flat gates points to slag; it, being very sticky, will adhere to the mold around the gates, instead of flowing as other dirt will. A flat gate also receives slag more readily than ordinary pouring gates, and they are not easily converted into skim gates. The question then is whittled down to the point, how to keep your ladle free from slag. If poured with newly lined ladles, and early in the heat, the castings would be found free from such blemishes. After a ladle has been used often, slag sticking below the lip will be liberated and flow at the bottom of the stream and cannot be skimmed with a rod."

An article by L. C. Jewett discusses the problem of providing sufficient vent for cores. Where cores are nearly surrounded by iron when the mold is cast, extraordinary provision should be made for escape of the gases. Cinders should be used in such cores, and as large a vent as possible should be made, a pipe extending from the print in the drag to a hole specially provided in the bottom-board is in some cases advisable.

Feb. 9. G. H. Willard has in this number an article describing means to produce "a quickly made pattern." It is accom-

panied by six figures, without which we cannot give an intelligible review.

Feb. 16. An illustrated article by R. H. Palmer describes the process of molding and casting a Harris-Corless engine-bed.

"A Trick in Pattern Making" is the subject of an article by G. H. Willard. This also is accompanied by figures, eight in number. The description is of a method adopted for making a 40-inch piston from a 48-inch pattern. It consisted of reducing thickness by setting a flat core in sections in the bottom of the mold, and circular segmend cores around the circumference. The method of constructing the core boxes is illustrated and explained.

THE FOUNDRY.

An article by I. B. Thomas describes and illustrates in detail a spraying device for blackening dry sand molds by compressed air.

L. C. Jewett writes about "Trouble with a Piston Casting." It was a large, hollow piston, and when the grooves were turned out for the expension rings an imperfect spot would appear, which, by the members of the firm and the workmen generally, was ascribed to shrinkage. Mr. Jewett, however, maintained that the trouble was due to gases from the core. The article is illustrated in plan, elevation and section.

An article on "Molding Cast Iron Columns," by John C. Knoeppel, is illustrated by seventeen figures, and the description of the molding and casting processes is very complete.

Under the caption, "A Snap," Oscar Oldman describes, by the aid of a diagram, what he considers the best style of hinge for a snap flask. The same writer has also an article on iron flask pins; this also is illustrated, in elevation and section.

"Cast Iron Flasks, Etc.," is the title of an article by R. D. Moore. Nine diagrams illustrate different styles of handles and pins, exhibiting correct and incorrect methods in comparison.

Wm. Z. Cruikshank gives a quick method of computing weight of casting from pattern dimensions.

"Some English Methods of Making Rope Pulleys" are explained by H. Sayers. He says:

"The old-fashioned way of making rope pulleys, as practiced in England, is to make the grooves in dry sand segment cores, and the arms in green sand cores, setting all on a level bed and covering with a flat cope. This crude practice still prevails in many shops.

"A better way is to ram up the rim to a one-foot section of pattern set to a mark scribed on the bed. In this case, greater care is necessary in setting the arm cores. In this latter operation it is usual to strike a line from center to circumference, set the edge of the first arm core thereby, which will act as a guide for setting the next, and so on to the end. The last core set should have about an inch shaved from the sides to insure its going to place without friction, any space left being filled up afterwards. The top may be covered by a flat green sand cope, or by loam plates.

"But the best way of all is to sweep the grooves in loam, on a ring. This should be done on a carriage having a sweep spindle in the center, so as to avoid handling till after it is dried. Set the arm cores in place on a level bed first, and then lower the loam ring down to position, covering with a flat green sand cope, or with loam plates."

John M. Richardson has an article treating of the tendency of wood to change its shape and the means necessary to neutralize this in the construction of wood patterns, employing a number of diagrams to assist in elucidation. The molder's definition of a good pattern would be "one that will draw easily, and not break the mold." * * *

A pattern is a means to en end, and not always the one that looks the best is that in reality. If the pattern is to be used much, no pains should be spared in order to thoroughly good construction; on the other hand, "it is a good deal like filching money from someone's pocket to fuss and putter and be overexact and nice on some cheap job where only one casting is desired."

Attention should always be paid to the influence of the rings of growth upon the warping of wood, as the skillful workman will thus be able to neutralize this influence in the completed pattern.

W. J. Keep writes on "Cold Shuts in Castings," and on "What Causes Dull Iron."

"As melted iron flows through a mold, a skin of oxide forms on the surface. If a similar stream of iron comes from an opposite direction, entering from another gate, its forward surface will be covered with a similar coating of oxide. When the surfaces meet, if the metal is hot enough, the surfaces will unite and the oxide will float to the top of the mold and a perfect union will take place; but if the iron is run very near solidification, the surfaces will press against each other, but no union will take place. Sometimes the metal will unite at some points and not at others. If the casting is thin, the cold shut may show on both sides. If thick, it may extend only a very short distance beneath the surface, there being a perfect union at the center and upper part of the casting. Such a cold shut weakens a casting just as the cut of a fine saw to the same depth would do, and, worse than that, we never know how deep it reaches.

"The prevention lies in the use of hotter iron or placing other gates so as to cause the iron to flow a less distance."

With regard to iron's changing from hot to cold, Mr. Keep says:

"I am inclined to think that such change is caused by a part of a pig of iron falling through into the hearth before it is melted. It would be melted by the fluid iron around it and might reduce the temperature of the iron in the hearth so much as to make the difference apparent in the stream at the tap-hole."

THE IRON AGE.

Feb. 16. Erastus C. Wheeler has an extended article in this number on "Malleable Cast Iron." The demand for malleable iron castings has grown, and is destined to continue to expand till it shall dominate the metal casting world. * * * It has

almost entirely superseded gray iron in freight car building. In this branch the chemist has been of greater benefit than in the gray iron industry. In malleable iron silicon is the dominating ingredient, the percentages of this alloy varying according to the weight of castings required; heavy castings requiring less silicon than light. There is a very reliable test for the amounts of silicon required in mixture, and careful manufacturers place great confidence in same. A test bar exactly twelve inches long and one-half inch thick is cast from every heat, and a micrometer reading is made off same. If the shrinkage is found to be greater than that allowed in patterns the silicon has been too low; if the contraction has been less the percentage of silicon was high, and it then resolves itself into a question for manipulation to adjust same, the idea all through being that a high silicon liquid iron will cool slower, with less contraction, than a low silicon, duller iron, with its greater shrinkage. The presence of a large percentage of silicon will assert itself when after annealing the fracture will show a wide white edge and is brittle.

Malleable cast iron is the direct result of decarbonizing cast iron by means of a sesquioxide which will impart a portion of its oxygen to the carbon in the metal at an annealing heat, producing CO, burning the carbon.

Sulphur is the most injurious of the impurities in iron of which malleable castings are to be made. It is probable that a basic lining for the air furnace will be found, in the near future, by which sulphur and phosphorus will be eliminated from the bath.

Feb. 23. Mr. Wheeler's second article on malleable iron appears in this issue.

The per cent. of carbon may be practically the same in No. 1 and No. 4 iron, but the silicon varies greatly, showing that the silicon changes the character of the carbon; in the former it will be largely graphitic, and in the latter combined with the iron.

In choosing a mixture for malleable iron there should be enough silicon present to insure fluidity, but not enough to cause segregation of the carbon into the graphitic state. The success

of malleable iron depends upon the elimination of carbon. Well-annealed malleables present a velvety fracture, but castings in which there is too much silicon will show a hard, crystalline fracture, and will be brittle. Mr. Wheeler presents tables showing that as silicon content diminishes the combined carbon increases. The influence of phosphorus and of manganese is also discussed at considerable length. Phosphorus is not a result of high heat in the blast furnace, as is silicon, but upon remelting, its prominence is directly attributable to heat generated in furnace. It depends entirely upon silicon for its assertive qualities.

Manganese is perhaps the most peculiar of the metalloids. In the East, it is fought by malleable iron makers, while in the West it is a welcome guest, and both sections produce excellent material. High manganese is said to diminish the necessity of using chills and promotes solidity and combination of the carbon. It also tends to flux off sulphur.

THE TRADESMAN.

Feb. 1. Writing upon cupola mixtures for foundries in isolated towns where pig iron freights are high, E. H. Putnam advises the use of high-silicon pig in order that a large per cent. of scrap may be carried. Scrap is procurable in considerable quantities near by, and therefore, the more of it that can be used, the better, from a money-saving standpoint.

The same writer, discussing the tendency of the metalloids to exert a uniform influence throughout the whole mass of a vessel of molten iron, says, in part:

"In a certain foundry where chilled plows and cane mills were the principal product, two cupolas were often running at the same time; and, when this was the case, the soft iron for cane mills was melted in the one cupola, and the chilling iron for plows in the other. The iron from either cupola was tapped in a large bull ladle, holding about 1,000 pounds, and from this was turned into the pouring ladles. It was the practice to test the chilling quality of the plow iron by casting a little on a chill before pouring. Sometimes the test from a nearly full ladle would show too hard. In this case a small amount of iron from

the other cupola would be poured into it, and another test, taken without waiting more than ten seconds, would show conclusively that the whole mass or volume was uniformly affected; that is, a volume of iron weighing 800 pounds, having 80 pounds of another grade of iron added was uniformly changed in grade, and in chilling tendency, as was further substantiated by the fact that the castings made from it were uniform in the characteristics of fracture."

Feb. 15. With regard to the character of the iron used in car wheels, Mr. Putnam says: "Some years ago, in a discussion carried on in these columns, it was claimed by some writers that the practice of making car wheels from coke iron had become common, and the impression was given that coke iron was considered by the manufacturers of car wheels to be equally as good as charcoal iron for the purpose. * * * There was no doubt that coke iron entered largely into the mixture, and, where the right kind was used, perhaps without detriment; but no doubt the charcoal element in the mixture was depended on for chilling tendency. * * * Messrs. Henderson and Walley, of the Norfolk & Western Railway, give the results of recent investigations in this line in the American Engineer and Railway Journal. Having decided as to the chemical requirements, they analyzed and tested twenty-seven samples of iron, the coke brand being conspicuous by its total absence, the samples being entirely of charcoal iron. * * * Whether the prediction of the final discontinuance of the production of charcoal iron shall be verified or not depends on future developments in metallurgy. * * * It would be foolish to deny the possibility of making iron by some other process than by charcoal smelting, that may be the equal of charcoal iron in every respect, chilling tendency included."